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# SUBMUCOSAL AGAINST INTRAMUSCULAR ADMINISTRATION OF DEXAMETHASONE IN TREATMENT OF POSTOPERATIVE EDEMA AFTER ODONTECTOMY OF IMPACTED MANDIBULAR THIRD MOLARS

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## ABSTRACT

**Aim**: To clinically evaluate the efficacy of Dexamethasone depending on the method of administration in the treatment of postoperative complications following odontectomy of lower impacted third molars.

**Materials and Methods**: At the Clinic for Oral Surgery at USKC "St. Panteleimon" in Skopje, North Macedonia, 45 patients, 20 to 40 years, indicated for odontectomy of lower impacted third molars, were included. 15 patients were treated with DXP (Dexamethasone), ampule of 4mg/1ml, applied submucosally (SM). Another 15 patients were treated with DXP administered intramuscularly (IM) into the deltoid muscle. No DXP was applied to the control group (CG). Edema was monitored by measuring three facial lines: tragus to labial commissure (Tr-Co), tragus to gnathion (Tr-Gn), and lateral eye canthus to angulus mandibulae (Cn-Am). The clinical effects in the three study groups were monitored at 24 hours (T1), 48 hours (T2), and 7 days (T3) post-op.

**Results**: Cn-Am direction in T1, showed significantly larger edema in the CG vs the examined groups. In all time points there were no statistically significant differences between the examined groups ($p>0.05$). In T1 and T2, in the Tr-Co direction, the results showed the biggest reduction of the edema with a statistically significant difference ($p=0.012$) in IM vs SM application at T2. T3 showed least edema in the SM group. Tr-Gn direction, at T1, a significant difference in edema dimensions was found between the IM and CG ($p=0.015$), indicating a significantly smaller measured edema in the IM group. Identical findings were seen at T2. T3 showed better results in edema control in the SM vs. other groups.

**Conclusion**: The intramuscular application technique of DXP was more effective than the submucosal technique across all measurement lines and time points in managing postoperative edema following surgical extraction of lower impacted third molars.

**Keywords**: Dexamethasone, submucosal administration, intramuscular, lower third molar, extraction

## INTRODUCTION

The presence of impacted molars in the jaws is a pathological condition and, due to its frequency in the population, represents a common problem for oral surgeons. The term impacted tooth is defined as the inability of a tooth to erupt into a proper/correct position/location in the dental arch during its usual period of eruption [1]. Impacted teeth are often associated with several pathological conditions such as pericoronitis, caries, periodontitis, resorption of adjacent tooth roots, cysts or neoplasms, germination defects, and they can

frequently cause additional difficulties in orthodontic and prosthetic treatment [1, 2].

The treatment of this condition requires surgical extraction of the impacted tooth. The routine surgical procedure for impacted teeth extraction is called odontotomy. It is most commonly performed on mandibular third molars, which account for the largest percentage of impactions [3]. It is a complex surgical intervention that causes trauma to both soft and hard tissues resulting in postoperative complications. These include pain, edema and trismus, which, if left untreated, can interfere with patients' daily activities and social functioning [4]. These complications are expected and are physiological reaction to the acute tissue inflammatory process, characterized by the classical signs of inflammation: pain, heat, redness, swelling and loss of function [5]. The inflammatory symptomatology is not identical in all patients, but it differs in both type and severity. It is heterogenous and shows significant variations among patients.

Postoperative complications are often treated with drugs, and the most widely used are corticosteroids due to their anti-inflammatory and anti-edematous potency. In practice, various corticosteroids are used to control pain, edema and trismus, such as betamethasone, triamcinolone, prednisolone, hydrocortisone, dexamethasone and methylprednisolone, [6]. The literature indicates that dexamethasone (DXP) is a corticosteroid, which is most frequently used drug in oral surgery, during various types of oral surgical procedures, and very often during surgical extraction of impacted teeth. DXP is a corticosteroid with longer duration of action, more than 36 hours, and has potent anti-inflammatory properties. In comparison to other corticosteroids, it is associated with fewer or negligible side effects [7].

In addition to DXP, many other drugs are being used in the treatment of postoperative complications. These include non-steroidal anti-inflammatory drugs, proteolytic enzymes [8], muscle relaxants, analgesics [9], and in some cases, locally applied preparations (solutions) [10, 11, 12] used either alone or in combination with antibiotics.

Postoperative sequelae are treated preoperatively (preventively), postoperatively or in both periods depending on the surgeon's approach. In the preoperative period, analgesics with anti-nociceptive effects are often used for alleviating and reducing pain [13]. In fact, there is no consensus regarding the route of DXP administration during oral surgery; hence, diversity exists with the drug being administered through local, parenteral or intravenous routes. In clinical practice, the type, dosage and route of corticosteroids administration are diverse, and they depend on the surgeon's preference [10, 11].

The existing dilemmas on the most effective route of drug administration in treatment of postoperative sequelae was the driving force for this study.

The aim of this study was to complete a clinical evaluation of dexamethasone efficacy depending on the route of administration in the treatment of postoperative complications following surgical extraction of mandibular third molars.

## MATERIAL AND METHOD

This study included 45 patients with impacted mandibular third molars indicated for surgical extraction. Patients were selected based on inclusion and exclusion criteria. The inclusion criteria were: patients aged 20-40 years of both genders, without systemic chronic diseases, and patients who were willing to participate in the study. Exclusion criteria were patients with poor oral hygiene and care, patients with systemic chronic diseases, pregnant women, patients who used psychotropic substances, chronic smokers, and patients who did not want to be part of the study.

The study was conducted at the Clinic for Oral Surgery at the University Dental Clinical Center "St. Panteleimon" in Skopje. After conducting an anamnesis and clinical examination, including an analysis of a panoramic x-ray (OPG) an indication for surgical extraction of the impacted third molar was determined. Written informed consent was obtained from all participants, and surgical extraction of the mandibular third molars was realized. The indicated procedure was performed under local anesthesia, complying with standard aseptic protocols. The surgical removal of the lower third molars was performed by using standard Ward's incision indicated for this procedure, forming adequate flap design. The following steps included standard adequate surgical technique resulting in tooth extraction. After surgical removal of the impacted tooth, the surgical wound was curetted and hemostasis was achieved by placing 3-0 surgical

silk single interrupted sutures, with which the surgical wounds were sutured.

After completing the surgical procedure, DXP was administered (either by submucosal or intramuscular route). Postoperative instructions were given to all patients regarding adequate oral hygiene, diet as well as wound care throughout the period of complete rehabilitation.

*Examined groups*

The first examined group consisted of 15 patients, who received submucosal injection of 4 mg/ml DXP near the surgical site immediately after the surgical procedure. The second examined group consisted of 15 patients who received intramuscular DXP in the deltoid muscle at the same time interval. The control group consisted of 15 subjects who did not receive DXP postoperatively. There was a total of 45 subjects.

The focus of this study was to evaluate the postoperative morbidity with emphasis on postoperative edema as one of the most common complications. Measurement and monitoring of postoperative edema was conducted according to the criteria of previously established measurements using the method described by Ustün. Three linear edema measurements were made: from tragus to labial commissure oris (Tr-Co), from tragus to gnation (Tr-Gn), and from lateral eye commissure, canthus to angulus mandibulae (Cn-Am) (Figure 1) [14].

**Image 1.** *Measurements and monitoring of edema by the method of Ustün*

Clinical effects obtained in the three examined groups were followed up for 24 (T1), 48 hours (T2), and 7 days (T3) after intervention.

All planned interventions including anesthesia, surgical extraction, measurements, and follow-up of the designated clinical parameters in this study were performed by the same oral surgeon.

The results obtained were compared based on the route of drug administration in the examined groups (submucosal or intramuscular) and in the control group, inter-group and within groups at three different time points: T1, T2 and T3.

*Statistical analysis*

Data were analyzed using the SPSS software package, version 26.0 for Windows. Qualitative parameters are presented as absolute and relative numbers. For analyzing the three measurements of edema dimensions, measures of central tendency (mean, median, minimum and maximum values) were calculated, as well as measures of dispersion (standard deviation). The Shapiro-Wilk W test was applied for determining the normality of data distribution for the performed measurements with the three routes of dexamethasone administration. The significance of differences between two and more numerical parameters with non-normal distribution was assessed using the Mann Whitney U test and Kruskal Wallis H test, respectively. To determine statistical significance, a two-tailed analysis with a significance level set at $p<0.05$was used. All obtained results are presented in tables and figures.

## RESULTS

The study included a total of 45 (n=100%) participants, who were analyzed for the efficacy of dexamethasone on postoperative edema dimensions at the three measurement points after the surgical extraction of impacted mandibular third molars. According to the route of dexamethasone administration, participants were divided into three groups (intramuscular, submucosal, control), each with an equal number of participants (n=15).

Edema was measured from canthus (Cn) to angulus mandibulae (Am) (Cn-Am) at three time points (T1, T2 and T3).

At T1, the largest edema dimensions were observed in the control group (9.33±5.38 mm), with min/max of 4/20 mm, and the smallest in the group treated with submucosal application (4.47±1.55 mm), with min/max of 2/6 mm. No

significant difference in the postoperative edema dimensions in the Cn-Am line between the two examined groups was determined (p=0.652), or edema in the submucosal group was non-significantly smaller than edema in the intramuscular group. A significantly more pronounced postoperative edema was observed in the control group compared to the examined groups (p<0.01) (Table 1, Graph 1).

At T2, the most significant reduction in edema was noted after intramuscular administration (2.40±1.30mm), with min/max of 0/4 mm, and the smallest in the control group (1.33±1.29mm), with min/max of 0/4 mm. A significant difference in reducing postoperative edema was determined along the Cn-Am line among the three groups (p<0.001), in favor of a significantly greater edema reduction with intramuscular administration compared to submucosal administration or control group. No significant difference in postoperative edema along the Cn – Am line at T2 was registered between the submucosal and control groups (p=0.095), that is, edema reduction in the control group was non-significantly smaller than in the submucosal group (Table 1, Graph 1).

At T3, the greatest edema reduction was noted in the control group (7.93±5.87 mm), with min/max of 0/20 mm, and the smallest in the intramuscular group (2.20±1.52 mm), with min/max of 0/4 mm. A significant difference in edema reduction along the Cn – Am line was registered among the three groups (p=0.0005) at T3.There was no statistically significant difference in reducing postoperative edema between the submucosal and intramuscular groups(p=0.215), that is, intramuscular administration of dexamethasone showed non-significantly smaller values than submucosal administration. The control group demonstrated a significantly greater edema reduction compared to the examined groups (p<0.01).

Intra-group comparison of postoperative edema at time points T1, T2, and T3 with different routes of administration along the measurement line Cn - Am is illustrated in Graph 1.

Measurement line tragus-commissure oris (Tr-Co).At T1, the largest edema dimensions along Tr-Co were observed in the control group (7.47±3.14 mm), with min/max of 5/11 mm, and the smallest with the intramuscular administration of dexamethasone (4.67±1.18mm), with min/max of 3/6 mm. There was a significant difference in dimensions of postoperative edema along Tr-Co among the three groups of participants (p=0.001). At T1, no significant difference in dimensions of postoperative edema along the Tr-Co line was found between the two examined groups (p=0.536), or edema in the intramuscular

**Table 1.** *Intra-group comparison of postoperative edema in Cn-Am based on route of dexamethasone administration at three measurement points*

| Intra-group comparison T1, T2, T3 | Edema (mm)Cn-Am | | | | p |
|---|---|---|---|---|---|
| | Number (N) | Mean± SD | (Min/Max) | Median | |
| **T1** | | | | | |
| **Intramuscular** | 15 | 4.60±1.50 | 0/7 | 5.0 | SM/IM p = 0.652 |
| **Submucosal** | 15 | 4.47±1.55 | 2/6 | 5.0 | SM/C p=0.0004* |
| **Control** | 15 | 9.33±5.38 | 4/20 | 7.0 | IM/Cp=0.002* |
| T2 | | | | | |
| **Intramuscular** | 15 | 2.40±1.30 | 0/4 | 2.0 | SM/IM p=0.078 |
| **Submucosal** | 15 | 1.87±1.51 | 0/4 | 2.0 | SM/C p=0,159 |
| **Control** | 15 | 1.33±1.29 | 0/4 | 1.0 | IM/C p=0.002* |
| T3 | | | | | |
| **Intramuscular** | 15 | 2.20±1.52 | 0/4 | 2.0 | SM/IM p=0.215 |
| **Submucosal** | 15 | 3.07-±3.76 | 1/15 | 2.0 | SM/C p=0.003* |
| **Control** | 15 | 7.93±5.87 | 0/20 | 6.0 | IM/C p<0.001* |
| ***significant p<0.05** | | | | | |

Cn-commissure lateralis oculi (canthus)

Am- angulus mandibulae

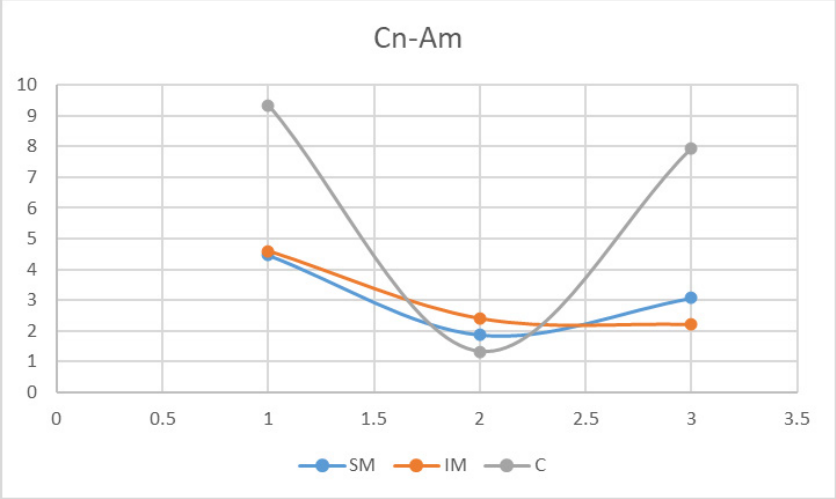


**Figure 1.** *Intra-group comparison of postoperative edema in measurement line Cn – Am based on the site of dexamethasone administration at three time points*

**Table 2.** *Intra-group comparison of postoperative edema in Tr-Co line based on the administration of dexamethasone at measurement time points*

| Intra-group comparison | Edema (mm)Tr-Co | | | | p |
|---|---|---|---|---|---|
| | Number (N) | Mean± SD | Min/Max | Median (IQR) | |
| **T1** | | | | | |
| **Intramuscular** | 15 | 4.67±1.18 | 3/6 | 5.0 | SM/IM p=0.536 |
| **Submucosal** | 15 | 5.20±1.52 | 3/10 | 5.0 | SM/C p=0.042* |
| **Control** | 15 | 7.47±3.14 | 5/11 | 107 | IM/C p=0.009* |
| T2 | | | | | |
| **Intramuscular** | 15 | 3.27±1.16 | 1/ 5 | 3.0 | SM/IM p=0.012* |
| **Submucosal** | 15 | 2.00±1.46 | 1/ 4 | 2.0 | SM/C p=0.095 |
| **Control** | 15 | 1.07±1.10 | 0/3 | 1.0 | IM/C p<0.001* |
| T3 | | | | | |
| **Intramuscular** | 15 | 1.47±1.55 | 0/ 6 | 1.0 | SM/IM p=0.0003* |
| **Submucosal** | 15 | 3.40±1.24 | 2/ 6 | 3.0 | SM/C p=0.0001* |
| **Control** | 15 | 6.60±2.56 | 2/ 12 | 6.0 | IM/C p<0.0001* |
| *significant p<0.05 | | | | | |

Tr-tragus
Co- labial commissure oris

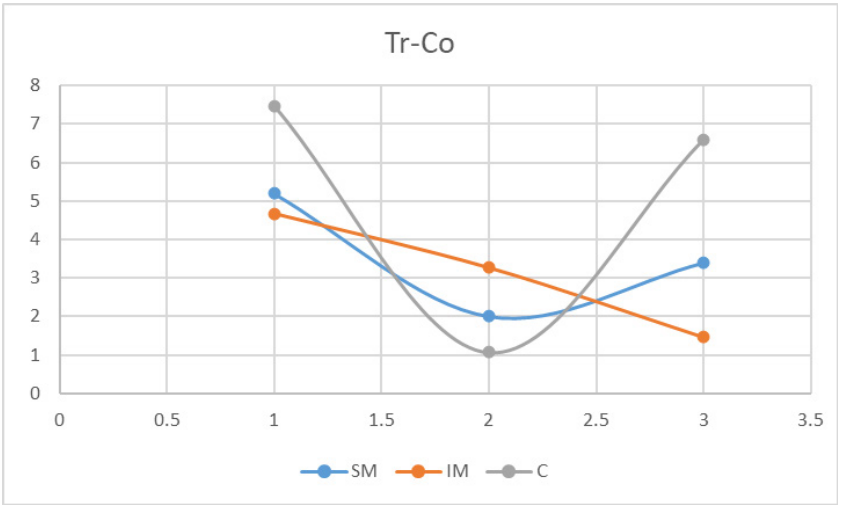


**Figure 2.** *Intra-group comparison of postoperative edema in Tr-Co based on the site of dexamethasone administration at the measurement time points*

group was non-significantly smaller compared to that in the submucosal group. A significantly greater postoperative edema was registered in the control group compared to the examined groups ($p<0.05$) (Table 2 and Graph 2).

At T2, a significant difference was found among the three groups of participants regarding the intensity of edema reduction along the Tr-Co line ($p<0.001$). The greatest reduction in edema was recorded in the intramuscular group (3.27±1.16 mm), with min/max of 1/5 mm, and the smallest in the control group (1.07±1.10 mm), with min/max 0/3 mm. A significant difference in reducing postoperative edema was registered in the Tr-Co line ($p=0.012$) in favor of intramuscular administration compared to submucosal. In addition, a substantial decrease in postoperative edema was observed with intramuscular dexamethasone administration in comparison to the control group ($p<0.001$). The reduction in postoperative edema in the submucosal group was non-significantly different from that in the control group ($p=0.095$) (Table 2, Graph 2).

At T3, the greatest edema reduction was noted in the control group (6.60±2.56 mm), with min/max of 2/12 mm, and the smallest in the intramuscular group (1.47±1.55 mm), with min/max of 0/6 mm. There was a significant difference in the edema reduction along the Tr-Co line among the three groups ($p<0.001$). At T3, a substantial significant difference in edema reduction was found between the submucosal and intramuscular groups($p=0.0003$) indicating more pronounced edema reduction with submucosal administration of dexamethasone. The best results were achieved in the control group, which showed a significant decrease in postoperative edema compared to both intramuscular ($p<0.0001$) and submucosal ($p=0.0001$) groups (Table 2, Graph 2). Intra-group comparison of postoperative edema at time points T1, T2, and T3 with different routes of administration in the measurement line Tr-Co is shown in Graph 2.

At T1, the largest edema dimensions along tragus-gnathion(Tr-Gn)were measured in the control group (6.93±3.67mm), with min/max of 3/15 mm, and the smallest in the intramuscular group of dexamethasone administration (4.67±1.18mm), with min/max of 3/10 mm. There was a significant difference in the dimensions of postoperative edema among the three groups of participants ($p=0.012$).A significant difference in the dimensions of postoperative edema along the Tr-Gn line was found between the intramuscular and control groups ($p=0.015$), in favor of a significantly smaller edema in the intramuscular group. At T1, a non-significant reduction in postoperative edema was observed in the control group compared to submucosal group ($p=0.608$).

The intramuscular group presented with a non-significantly smaller postoperative edema

**Table 3.** *Intra-group comparison of postoperative edema (Tr-Gn) based on the site of dexamethasone administration at the measurement time points*

| Intra-group comparison | Edema (mm)Tr-Gn | | | | p |
|---|---|---|---|---|---|
| | Number (N) | Mean± SD | Min/ Max | Median (IQR) | |
| **T1** | | | | | |
| **Intramuscular** | 15 | 3.87±1.30 | 0/ 5 | 4.0 | SM/IM p=0.096 |
| **Submucosal** | 15 | 5.73±3.15 | 2/ 10 | 5.0 | SM/C p=0.608 |
| **Control** | 15 | 6.93±3.67 | 3/ 15 | 6.0 | IM/C p=0.015* |
| T2 | | | | | |
| **Intramuscular** | 15 | 2.40±1.06 | 0/ 4 | 3.0 | SM/IM p=0.812 |
| **Submucosal** | 15 | 2.33±1.84 | 0/ 6 | 2.0 | SM/C p=0.036* |
| **Control** | 15 | 1.07±1.03 | 0/ 3 | 1.0 | IM/C p=0.023* |
| T3 | | | | | |
| **Intramuscular** | 15 | 1.33±1.05 | 0/ 3 | 2.0 | SM/IM p=0.005* |
| **Submucosal** | 15 | 3.40±2.06 | 0/ 7 | 3.0 | SM/C p=0.042* |
| **Control** | 15 | 5.87±3.17 | 2/ 12 | 5.0 | IM/C p<0.001* |
| *significant p<0.05 | | | | | |

Tr: tragus
Gn: gnathion

than the submucosal group (p=0.096) (Table 2, Graph 2).

At T2, a significant difference among the three groups of participants was registered regarding the intensity of edema reduction along the Tr-Gn line (p=0.019). The greatest edema reduction was noticed in the intramuscular group (2.40±1.06mm), with min/max of 0/4 mm, and the smallest in the control group (1.07±1.03mm), with min/max of 0/3 mm. No significant difference was recorded in reducing postoperative edema along the Tr-Gn line between the submucosal and intramuscular groups (p=0.812), but edema reduction was significantly smaller in the control group compared to both the submucosal (p=0.036) and intramuscular (p=0.023) groups (Table 3, Graph 3).

At T3, the most pronounced edema reduction was detected in the control group (5.87±3.17mm), with min/max of 2/12 mm, and the smallest in the intramuscular group (1.33±1.05mm), with min/max of 0/3 mm. There was a significant difference in the values regarding edema reduction along the Tr-Gn line among the three groups (p<0.001). A statistically significant difference was observed in edema reduction between the submucosal and intramuscular groups (p=0.005), in favor of greater edema reduction with submucosal administration of dexamethasone. Best results were achieved in the control group with significant differences compared to both the intramuscular (p<0.001) and submucosal(p=0.042) groups (Table 3, Graph 3).

Intra-group comparison of postoperative edema at time points T1, T2, and T3 for different routes of administration along the Tr-Gn line is presented in Graph 3.

## DISCUSSION

Postoperative clinical manifestations, which are a result of surgical tooth extraction, depend on many factors such as the patient's individual physiological response to trauma, the extent of tissue trauma, duration of the procedure, tissue manipulation, among many others. Similar to many other surgical interventions, the extraction of impacted mandibular wisdom teeth is frequently associated with numerous complications. Edema together with pain and trismus is one of the most commonly expected postoperative clinical sequelae. Although edema development in the facial region is an expected complication, its excessive manifestation can cause considerable discomfort to patients. Postoperative edema after surgical extraction of impacted mandibular third molars can be of extensive dimensions, first of all due to the fact that maxillofacial region is richly vascularized and has areas built of loose connective tissue [15].

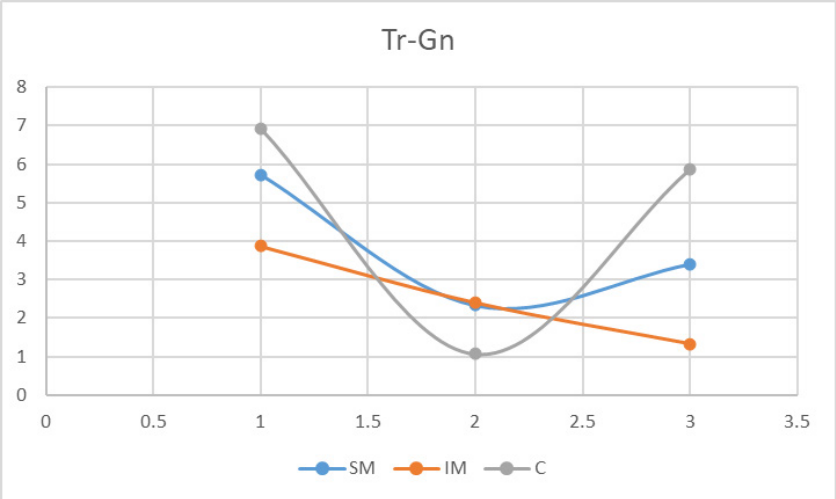


**Figure 3.** *Intra-group comparison of postoperative edema in Tr-Gn according to the application site of dexamethasone at the measurement time points*

*Explanation for figures 1,2 and 3:*
*SM - group with submucous administration*
*IM - group with intramuscular administration*

To ensure adequate therapy for postoperative complications, oral surgeons use corticosteroids. They suppress the release of tissue mediators of inflammation, thereby reducing transudation of fluids in tissues and lessening edema.

Dexamethasone is the most widely used corticosteroid. It has potent anti-inflammatory properties and prolonged duration of action, between 36 and 72 hours, but it does not impair mineral metabolism [16]; its mechanism of action involves reduction in the production of leukocytes and macrophages at the site of inflammation, which in turn suppresses prostaglandin synthesis. It also has a negative impact on the regulation of genesis of cytokines in macrophages, endothelial cells and lymphocytes [17]. The effects and mechanisms of corticosteroid action (DXP) are well known, but the efficacy of the drug administered via different routes in the organism is still under debate. Its use in practice is mainly based on the surgeon's individual preferences or experience.

In the literature, there are various comparative studies discussing different techniques aimed at determining which technique of drug administration is most suitable for treatment of postoperative sequelae [18]. For example, Priyanga et al. [18] compared sublingual and intramuscular administration of DXP and concluded that sublingual route was superior in treatment of pain, swelling and trismus. They also found sublingual route to be more suitable since it requires fewer technical skills and is better tolerated by patients. Some studies have also examined the efficacy of oral DXP administration on pain, swelling and trismus [17].

In our study, we administered 4 ml/1 ml of DXP by submucosal and intramuscular route following surgical extraction of impacted mandibular third molars to determine the effect of these two techniques on postoperative edema. Our results showed a significant postoperative edema reduction in the examined groups compared to the control group, which did not receive DXP.

The intensity or dimension of edema was evaluated at three measurement lines: Cn-Am, Tr-Co and Tr-Gn.

The results of this study for the Cn-Am line at T1, i.e., 24 hours postoperatively, showed no significant difference between the two routes of DXP administration (intramuscular and submucosal). At the first postoperative check-up, the control group of participants had a statistically significantly greater edema in comparison to that in the examined groups. The findings in the control group were significantly different from the two examined groups ($p<0.01$), while there was no difference between the groups treated via submucosal and intramuscular routes ($p=0.652$). However, at T2, 48 hours following the intervention, a statistically significantly greater edema reduction was noted with intramuscular administration of DXP in comparison to the other routes.

Submucosal DXP administration resulted with a smaller effect in edema elevation at this time point and was similar with the finding in the control group. The results from the measurements of the participants in the intramuscular group were significantly different from those in the control group ($p=0.002$), while no significant difference was observed in the findings between both examined groups ($p=0.078$), as well as between patients in the control group and submucosal group ($p=0.159$).

At T3, seven days following the intervention, the best result was achieved in the control group. The results from the control group were statistically significantly different from that in both examined groups. However, we assume this result was due to the fact that in the groups where DXP was administered, edema was reduced to a great extent up to 48 hours postoperatively, and it persisted in the control group during the same period. Therefore, edema reduced slowly, but this process was finished by the seventh day after the intervention, which was influenced by concurrent use of proteolytic enzymes, antibiotics, non-steroidal anti-inflammatory drugs. The results obtained in the control group were significantly different from those in the submucosal and intramuscular groups ($p<0.01$), whereas no difference was registered between the two examined groups ($p=0.215$).

Intramuscular DXP administration was compared with oral systemic application of DXP in some studies [18], and several other studies compared it with submucosal or intravenous DXP administration. Additionally, some have compared several techniques [21] in order to identify which is the most effective route of DXP administration in treatment of postoperative complications. Also, current studies include examined groups where DXP was admin-

istered in combination with anesthetics [22] or with analgesics [23].

Different studies present variations regarding the time of DXP administration, either before or after the surgical procedure, whether a single or double dose should be used, and comparing the effect of DXP with that of other corticosteroids administered via different routes [6, 24].

Sitthisongkhram et al. [7] reported no statistically significant differences in the postoperative complications (swelling, pain and trismus) whether DXP injection was administered pre- or postoperatively.

On the Tr-Co line, 24 hours postoperatively, a more pronounced edema was observed in the control group. By contrast, at T1, both submucosal and intramuscular DXP administration provided significantly better results than in the group which did not use DXP. Nevertheless, no significant difference in the effect was noted between different routes of drug administration at this time point. The results obtained for the control group were significantly different from those in the two examined groups ($p<0.05$), while no significant difference was registered between submucosal and intramuscular groups ($p=0.536$).

At T2, a significantly better effect was registered with intramuscular than submucosal administration. Intramuscular administration proved to be most efficient in edema treatment compared to submucosal application and the control group ($p<0.05$). The findings in the submucosal group were statistically significantly worse indicating that after 48 hours postoperative intramuscular administration would make more significant reduction of postoperative edema than if the drug was given by submucosal route. The difference between submucosal and control groups was non-significant ($p=0.095$).

After 7 days postoperatively, the control group showed the greatest edema reduction. It was statistically significantly different than in the examined groups. It seems that one dosage of postoperative DXP administration has a powerful anti-edematous effect in the early postoperative period, and in the subsequent period of edema suppression the effect of the other drugs that patients use during rehabilitation is being more pronounced. Our findings showed a significant difference among the three groups ($p<0.001$).

Regarding the Tr-Gn line, 24 hours postoperatively, our results pointed that the intramuscular DXP group showed statistically significantly less swelling than the control group ($p=0.015$). Although submucosal group exhibited smaller edema, it was not significantly different from that in the control group ($p=0.608$). At T1, no significant difference was observed between intramuscular and submucosal groups ($p=0.096$).

Forty-eight hours postoperatively, the best result was registered in the treatment of edema with intramuscular drug administration, although not significantly different from that with submucosal drug administration ($p=0.812$). Participants in the control group presented with worse outcome in postoperative edema reduction than those in the examined groups. By the 7th postoperative day, the best result was recorded in the control group ($p<0.001$), which in fact, is a characteristic result at this time point in all measurement lines for evaluation of postoperative edema. At this time point, the submucosal group demonstrated a significantly better result in edema reduction than the intramuscular group ($p=0.005$).

These results at T3 suggest that edema was reduced in the largest number of examined participants up to 48 hours postoperatively. This additionally underscores the strong/powerful effect that DXP has on edema suppression, particularly in the early postoperative period. There is vast research verifying the positive effect of submucosal dexamethasone administration on postoperative complications [18, 25, 26]. This research emphasizes the superiority of this technique over oral, intramuscular and intravenous drug administration. Moreover, submucosal technique is considered painless, easy to perform and well tolerated by patients.

However, in our study we observed better effect with regard to elevation of postoperative edema across all measurement lines by the method of Ustün. Our findings are in agreement with those of Aljohani et al. [27], who also demonstrated a significantly better effect on postoperative edema treated with intramuscular dexamethasone administration. Also, our results align with those of Priyanga et al. [18], who particularly emphasize the positive action of the drug within 24 hours postoperatively.

## CONCLUSION

Both routes of DXP administration demonstrated significant results in reducing postoperative edema after surgical extraction of impacted mandibular third molars, but intramuscular administration was more effective in all three measurement lines and time points. A pronounced anti-edematous effect was particularly evident during the early postoperative period (within the first 24 hours) with a sustained reduction in postoperative edema up to 48 hours following the procedure. Therefore, we promote intramuscular DXP administration as a more efficient route than submucosal in treatment of postoperative edema after surgical extraction of impacted mandibular third molars.

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**Резиме**

## СУБМУКОЗНА НАСПРОТИ ИНТРАМУСКУЛНА АПЛИКАЦИЈА НА ДЕКСАМЕТАЗОН ВО ТРЕТМАНОТ НА ПОСТОПЕРАТИВНИОТ ЕДЕМ ПО ОДОНТЕКТОМИЈА НА ДОЛНИ ИМПАКТИРАНИ УМНИЦИ

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**Цел**: Клиничка евалуација на ефикасноста на дексаметазон во зависност од начинот на апликација во третманот на постоперативни компликаци од одонтектомија на долните импактирани умници.

**Материјал и метод**: На Клиниката за орална хирургија при УСКЦ „Свети Пантелејмон“ во Скопје, Македонија, опфатени се 45 испитаници од 20 до 40 години старост, со индикација за одонтектомија на долните трети импактирани молари. Кај 15 испитаници аплициран е DXP, ампула од 4 mg/ml, субмукозно (SM), а кај 15 е апликациран DXP интрамускулно во делтоидниот мускул. Во контролната група не е аплициран DXP. Следењето на отокот е реализирано преку мерење на три лицеви линии: трагус до лабијална комисура(Tr-Co), трагус до гнатион (Tr-Gn), латерален кантус до angulus mandibulae (Cn-Am). Клиничките ефекти во трите испитувани групи беа следени 24 часа (T1), 48 часа (T2) и 7 дена (T3) по интервенцијата.

**Резултати**: Cn-Am насока во T1 покажа значително поголем едем во CG, споредено со испитуваните групи. Во сите временски точки не постоеше статистички значајна разлика меѓу испитуваните групи ($p > 0,05$). Во T1 и T2, во Tr-Co насока, резултатите покажаа најголемо повлекување на едемот со статистички значајна разлика ($p = 0,012$), со предност на IM, споредено со SM, применета во време T2. T3 покажа најмал едем во групата SM. Во Tr-Gn насока, во T1, беше најдена значајна разлика во димензиите на едемот меѓу IM и CG ($p = 0,015$), што индицира значително помал измерен едем во групата IM. Идентични наоди имаше во T2. Во T3 се покажа подобра контрола на едемот во групата SM, споредено со другите групи.

**Заклучок**: Интрамускулната техника на апликација на DXP е поефикасна од субмукозната во сите мерни линии и временски точки во третманот на постоперативниот едем по хируршка екстракција на долните трети импактирани молари.

**Клучни зборови**: Dexamethasone, субмукозна администрација, интрамускулна, долен трет молар, екстракција